Kidney International, Vol. 22 (1982), pp. 63–68

The frequency of kidney and urinary tract diseases in a defined population

ROBERT A. HIATT and GARY D. FRIEDMAN

The Department of Medical Methods Research, Kaiser-Permanente Medical Care Program, Oakland, California

The frequency of kidney and urinary tract diseases in a defined population. The frequencies of kidney and urinary tract diseases (KUTD) in a defined population are presented. Rates of first hospitalizations with KUTD in the 5-year period, 1971 through 1975, were determined among over 1 million members of the Kaiser Foundation Health Plan (KFHP) of Northern California. Cases were identified from computer-stored ICDA-coded final discharge diagnoses for hospitalizations. Kidney and other urinary tract diseases were final diagnoses in 35.7 first hospitalizations per 10,000 members per year in the period 1971 through 1975. Disease-specific rates were highest for urinary tract infections, benign prostatic hypertrophy, and renal and ureteral calculi. The frequency of KUTD in this population is compared to available rates from other sources.

Fréquence des maladies rénales et des voies urinaires dans une population définie. Les fréquences des affections du rein et des voies urinaires (KUTD) dans une population définie sont présentées. Les fréquences de première hospitalisation pour KUTD pour une période de cinq ans, de 1971 à 1975, ont été déterminées chez le million de membres de la Kaiser Foundation Health Plan (KFHP) de Californie du Nord. Les cas ont été étudiés à partir des diagnostics de sortie des hospitalisations mis dans un ordinateur avec le code ICDA. Les affections du rein et les autres affections du tractus urinaire ont constitué le diagnostic final des 35,7 premières hospitalisations pour 10 000 membres par an, dans la période 1971–1975. Les fréquences de maladies spécifiques étaient grandes pour les affections des voies urinaires, l'hypertrophie prostatique bénigne, et les calculs rénaux et urétéraux. La fréquence des KUTD dans cette population est comparée aux fréquences disponibles par d'autres sources.

Recent concern over the increasing medical and social costs of kidney and urinary tract diseases (KUTD) and of endstage renal disease in particular [1] has highlighted a virtual absence of population-based data concerning the frequency of occurrence of this group of illnesses [2]. The Advisory Committee on Epidemiology and Statistics of Kidney Disease, at a meeting sponsored by the National Kidney Foundation in 1972, found no accurate data on the risk of kidney disease in the general population and none has been forthcoming since that time. Most information on the frequency of KUTD is derived from mortality statistics or on disease occurrence in hospital or clinic settings that do not have a clearly defined population-at-risk [3].

The Kaiser Foundation Health Plan (KFHP) of Northern California has a membership of over 1 million persons, primarily in the San Francisco Bay area, that is demographically representative of the general population in that area. Data have been collected and stored in computers for clinical, administrative, and research purposes. This report presents rates of occurrence of major KUTD in this population from 1971 through 1975.

Methods

Over 1 million subscribers to the KFHP in northern California are provided with complete hospital and outpatient care at 15 facilities in the San Francisco Bay and Sacramento areas. Most people join KFHP through their place of employment or as individuals after passing a medical examination. The membership consists of a broad socio-economic and racial spectrum representative of the area population. In 1970, in the San Francisco-Oakland standard metropolitan statistical area, the KFHP membership comprised 18.7% of the total population as enumerated by the 1970 United States Census; the age and sex distribution of the two groups was almost identical (Table 1). In 1971, results of a telephone survey performed for administrative purposes on a random sample drawn from the KFHP membership list [4] indicated that blacks and persons at both ends of the income distribution comprised slightly less of the health plan membership than of the census population (Table 2). Although these latter comparisons are only approximations, because of potential response bias in the telephone survey, these data taken together with the age and sex characteristics (Table 1) indicate that the health plan membership is similar to the general area population.

A hospital discharge file stored data on all hospitalizations in KFHP hospitals in northern California including discharge diagnoses and pertinent demographic information. The first three or "primary" discharge diagnoses were derived from 506,782 hospitalizations by 352,322 subscribers in the 5-year period, 1971 to 1975. We used codes from the *International Classification of Diseases, Adapted* Eighth Edition (ICDA-8) to identify persons hospitalized with KUTD. We did not differentiate between the discharge diagnosis for which a patient was hospitalized and other primary diagnoses discovered during hospitalization. Thus, rates reflect hospitalizations *with*, and not necessarily due to, the diseases in question. Additional diagnoses after the first three were not included in the analysis.

Received for publication December 10, 1980
and in revised form January 11, 1982

0085–2538/82/0022–0063 $01.20

Table 1. Comparison of the age and sex distribution of Kaiser Foundation Health Plan (KFHP) members served by facilities in the San Francisco-Oakland standard metropolitan statistical area in March 1970 to the population enumerated by the 1970 United States Census in the same region

	KFHP members		U.S. Census population	
Age	Men %	Women %	Men %	Women %
0 to 9	19.7	18.7	16.9	15.5
10 to 19	20.9	19.8	18.0	16.8
20 to 29	14.2	17.0	17.1	17.0
30 to 39	13.2	12.7	12.4	11.6
40 to 49	13.1	13.4	12.7	12.8
50 to 59	10.5	10.3	10.8	11.0
60 to 69	5.9	5.6	7.1	7.9
70+	2.6	2.5	4.9	7.5
Total	*100.1*	*100.0*	*99.9*	*100.1*
Number	287504	293637	1520252	1589267

Table 2. Comparison of race and income level of a random sample Kaiser Foundation Health Plan (KFHP) members in June 1971 to the population enumerated by the 1970 United States Census in the San Francisco-Oakland standard metropolitan statistical area

	KFHP members %	U.S. Census population %
Race		
White[a]	84	83
Black	8	11
Other	8	6
Total	*100*	*100*
Number	1046	3109519
Income		
Under $7,000	17	22
$7,000 to 9,999	19	11
$10,000 to 14,999	36	35
$15,000 and over	21	32
Not reported	7	
Total	*100*	*100*
Number	1046	776750

[a] Includes Latin (and Mexican) Americans.

The denominator population was 1,158,840 members, as measured at the midpoint of the study in June 1973.

We sought validation of these data in two ways. To assess how accurately the recorded diagnostic code reflected the presence of disease, we first reviewed the medical records of a sample of 60 patients with urinary tract infection and another sample of 55 with urolithiasis. We considered the diagnosis accurate if historical, clinical, or laboratory evidence for the presence of that disease was recorded during the study period. In this review, we confirmed that the diagnosis was present during the hospitalization in 55 (92%) of the cases of urinary tract infection during the hospitalization in question. In 52 (95%) of the urolithiasis cases, urinary tract stones were present at hospitalization although upper tract stones were recorded incorrectly as bladder stones in six of 15 cases coded as having lower urinary tract urolithiasis.

The second means of validating our numerator information was a review of medical records of 500 hospitalized patients chosen at random from the list of persons without KUTD coded in their first three discharge diagnoses during the study period. In this review, 11 (2.2%) had evidence of KUTD not detected by our computer analysis of discharge diagnoses. Of these, three were missed because they were not within the first three coded diagnoses and two were not coded. The remaining six had laboratory evidence of urinary tract infection which was not listed as a diagnosis at discharge. Seven of these 11 patients with missed diagnoses were over 65 years of age and had disease in multiple organ systems.

Results

Kidney or urinary tract disease was included in the primary discharge diagnoses of 26,851 hospitalizations in the 5-year period, or 529.8 per 10,000 hospitalizations per year (Table 3). The rate of KUTD hospitalizations in this period, obtained by counting only the first KUTD hospitalization for each individual in this period, was 35.7 per 10,000 members per year. Relatively more men were hospitalized with KUTD than women, among both the membership and those members who were hospitalized for any reason. The rate of KUTD hospitalization was lowest in those aged 10 to 19 years (10.3 per 10,000 men and 10.7 per 10,000 women per year) and climbed steadily with age, reaching a rate of 265.1 per 10,000 men and 109.6 per 10,000 women per year in the group over age 65 years (Fig. 1). Because of the large size of the population studied, standard errors for these rates were always within 3.6% of the rate.

The most common diagnoses were for urinary tract infections (ICDA 590.0 to 590.9, 595, 599.0), benign prostatic hypertrophy (ICDA 600) and renal and ureteral calculi (ICDA 592). Age-specific rates for these conditions plus bladder cancer (ICDA 188) (Fig. 2) show that these major KUTD's primarily affect persons in the later years of life, usually over 50 years of age. There is a substantial incidence of hospitalization with urinary tract infection for women throughout life.

The incidence of initial hospitalization for urinary tract infection was 10.2 per 10,000 members per year (Table 4). Within this broad ICDA category, the specific diagnoses of infections of the kidney (ICDA 590.0 to 590.1) and cystitis

Table 3. Incidence rates of kidney urinary tract disease (KUTD) hospitalizations among subscribers to the Kaiser Foundation Health Plan (KFHP) in northern California, 1971 to 1975

	Men	Women	*Total*
Initial KUTD hospitalizations			
Number	10,745	9,948	*20,693*
No./10,000 members/yr	37.4	34.0	*35.7*
No./10,000 initial hospitalizations	771.2	467.1	*587.3*
All KUTD hospitalizations			
Number	14,497	12,354	*26,851*
No./10,000 members/yr	50.5	42.2	*46.3*
No./10,000 hospitalizations	715.4	406.2	*529.8*

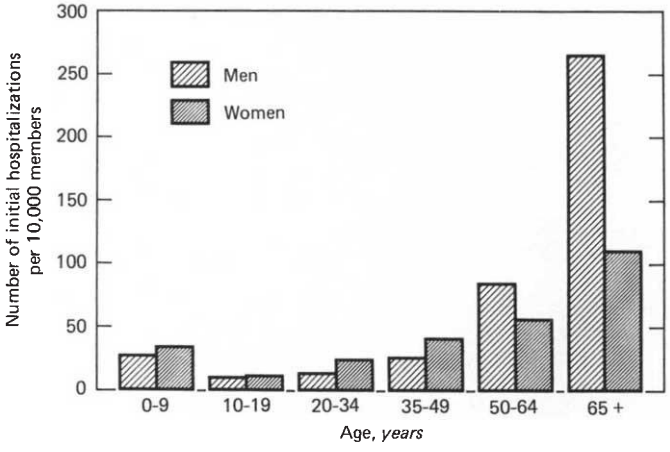

Fig. 1. *Age- and sex-specific rates of initial hospitalization with any kidney and urinary tract disease (KUTD) per 10,000 health plan members (1971 to 1975).*

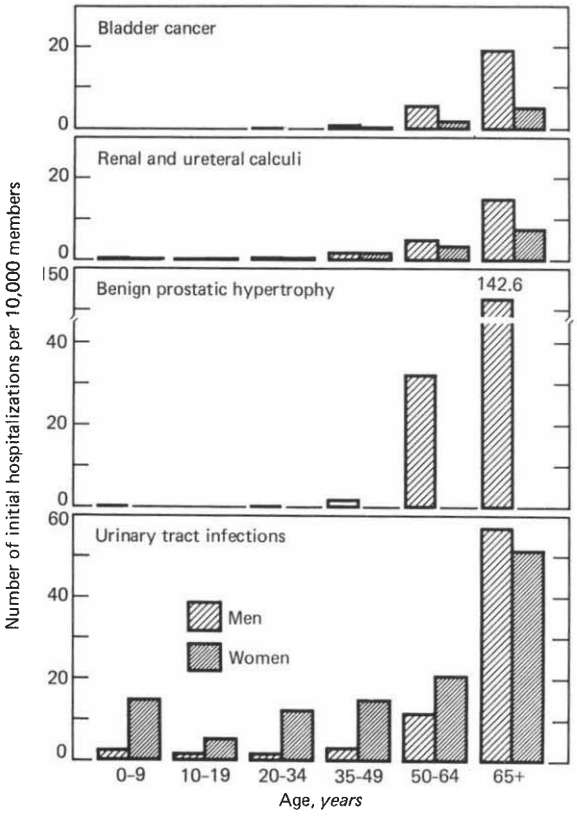

Fig. 2. *Age- and sex-specific rates of initial hospitalization per 10,000 health plan members with four major kidney and urinary tract diseases (KUTD) (1971 to 1975).*

(ICDA 595) accounted for 2.18 and 1.86/10,000 respectively, or only 40.1% of all urinary tract infection; the remainder were called simply urinary tract infection, not elsewhere classified (NEC) (ICDA 599.0). Probably most urinary tract infection (NEC) was either pyelonephritis or cystitis, and the true incidence of hospitalization with cystitis or infections of the kidney is somewhat higher than indicated above.

Nonspecific diagnoses also appeared elsewhere, under the categories of unspecified nephritis (ICDA 583) and of unspecified urinary tract neoplasms (ICDA 237.3 to 237.9). This would mean that the true rates of specific forms of nephritis and of these neoplasms are somewhat higher. The categories, other diseases of the kidney (ICDA 593.0 to 593.2) and other diseases of the ureter (593.3 to 593.5, 1,807 cases) include an assortment of diseases, most of which are anatomic abnormalities. The only ICDA categories not listed in the table were urinary tract tuberculosis (ICDA 016.0, 016.1, and 019.2), renal arteritis (ICDA 446.1 and 446.3), and renal sclerosis (ICDA 584), each of which accounted for less than 50 cases over the 5-year study period.

Discussion

The value of these data is that they approximate, with limitations to be discussed, the incidence of persons hospitalized with KUTD in a defined population who are members of a large prepaid health plan. Because the membership have reasonably good demographic similarities to the general population in the San Francisco Bay area, these figures may be useful to place these diseases in perspective for planning and research purposes. We are aware of no other descriptive information on KUTD that is comparable to that presented here.

Other reports that present data on the frequency of KUTD in populations are either based on prevalence figures or limited to specific diseases. The National Health Survey of 1973 [5] queried a random sample of the U.S. population about their health experience in the preceding year and found a period prevalence of 28.0 per 1,000 persons for all urinary system disease and prevalences of 0.7 per 1,000 and 3.3 per 1,000 persons for nephritis and calculus of the kidney and ureter, respectively. These are prevalence figures based on a survey questionnaire rather than incidence rates based on physicians' diagnoses in a medical center setting. Although the figures are population-based, their validity is questionable because responses to questions not confirmed by clinical records may be inaccurate.

Although limited to cancer, incidence rates from the Third National Cancer Survey [6] are perhaps the most comparable to ours in terms of methodology and populations studied. In the San Francisco-Oakland standard metropolitan statistical area in the period from 1969 through 1971, annual incidence rates for

Table 4. Incidence rates and male-to-female ratios of these rates of initial hospitalizations[a] with specific major kidney and urinary tract diseases among subscribers to the Kaiser Foundation Health Plan in northern California, 1971 to 1975

Disease category	ICDA code	No./5 years	± SEM No./10,000 Members/year	M:F
Neoplasms				
Malignant Bladder Neoplasm	188	664	1.15 ± 0.04	3.35
Malignant Kidney/Ureter Neoplasm	189.0 to 0.2	266	0.46 ± 0.03	2.03
Benign Urinary Tract Neoplasm	223.0 to 0.9	150	0.26 ± 0.02	1.66
Benign Kidney/Ureter Neoplasm	223.0 to 0.2	16	0.03 ± 0.01	2.24
Benign Bladder Neoplasm	223.3	101	0.17 ± 0.02	1.76
Unspecified Urinary Tract Neoplasm	237.3 to 0.9	92	0.16 ± 0.02	3.24
Unspecified Kidney/Ureter Neoplasm	237.3 to 0.5	43	0.07 ± 0.01	2.96
Unspecified Bladder Neoplasm	237.6	46	0.08 ± 0.01	3.67
Vascular				
Hypertensive Renal Disease	400.3, 403, 404	307	0.53 ± 0.03	1.23
Renal Artery Arteriosclerosis/Embolism	440.1, 444.3	70	0.12 ± 0.01	1.21
Renal Artery Arteriosclerosis	440.1	39	0.07 ± 0.01	1.07
Nephritis and nephrosis				
Acute Nephritis	580	95	0.16 ± 0.02	1.75
Nephrotic Syndrome	581	151	0.26 ± 0.02	1.68
Chronic Nephritis	582	218	0.38 ± 0.03	1.40
Unspecified Nephritis	583	180	0.31 ± 0.02	1.46
Infection				
Urinary Tract Infections	590.0 to 0.9, 595.0 to 0.9, 599	5,909	10.20 ± 0.13	0.40
Pyelonephritis	590.0 to 0.1	1,262	2.18 ± 0.06	0.35
Cystitis	595	1,078	1.86 ± 0.06	0.36
Hydronephrosis	591	350	0.60 ± 0.03	1.25
Calculus				
Urinary Tract Calculus	592, 594	2,145	3.70 ± 0.08	2.59
Kidney/Ureter Calculus	592	1,911	3.30 ± 0.08	2.49
Bladder/Urethra Calculus	594	285	0.49 ± 0.03	3.74
Other				
Other Diseases of the Kidney	593.0 to 0.2	899	1.55 ± 0.05	1.47
Acute Tubular Necrosis	593.1	38	0.07 ± 0.01	1.02
Other Diseases of the Ureter	593.3 to 0.5	908	1.57 ± 0.05	0.63
Bladder				
Bladder Fistula/Diverticulum/ Contracture/Paralysis	596.0 to 0.9	882	1.52 ± 0.05	2.12
Bladder Diverticulum	596.1	88	0.15 ± 0.02	8.94
Bladder Contracture	596.2	211	0.36 ± 0.03	8.33
Urethra				
Urethritis (Nonvenereal)	597	150	0.26 ± 0.02	1.62
Urethral Stricture	598	1,056	1.82 ± 0.06	1.66
Urethral Caruncle/Other Diseases	599.2, 599.9	261	0.45 ± 0.03	0.71
Prostate				
Benign Prostatic Hypertrophy	600	3,085	10.75[b] ± 0.19	—
Prostatitis	601	365	1.27[b] ± 0.07	—
Other Diseases of the Prostate	602	57	0.20[b] ± 0.03	—
Anomalies				
Renal Agenesis	753.0	70	0.12 ± 0.01	1.14
Cystic Kidney Disease	753.1	144	0.25 ± 0.02	1.75
Obstructive Deformity of the Ureter	753.2	87	0.15 ± 0.02	1.44

[a] Rates were based on entire member population of 1,158,840 in June, 1973.
[b] Rates were based on male population only.

malignancies of the kidney and bladder were 0.58 per 10,000 and 0.83 per 10,000, respectively, age adjusted to the KFHP population. In the KFHP population the annual rates of initial hospitalization for these cancers were 0.46 per 10,000 members and 1.15 per 10,000 members, respectively.

For various methodologic reasons, other comparisons with specific diseases are more difficult. In urinary tract infections, the most common affliction of the urinary system, it is difficult to differentiate between renal and bladder origin [7], and considerable nonspecificity and overlap exist in physician diagnoses. It is often not indicated in medical records whether a urinary tract infection is of the lower or upper urinary tract even if the doctor had good reason to suspect one or the other site to be the primary location. Also, far more urinary tract infections are diagnosed and treated in the outpatient clinic than in the hospital. Gaymans et al [8] reported an annual incidence rate of 59 per 1,000 population for all types of urinary tract infection in adult women (over 15 years old) in a Dutch general practice, and Kass [3] cited a prevalence for urinary tract infection of over 40 per 1,000 female population on the basis of symptoms reported in a house-to-house survey. For women 20 years and over only 2.0/1000 members were hospitalized with urinary tract infections in our study. However, unpublished data based on outpatient visits to our San Francisco facility from 1970 through 1972 indicate that, in women 20 years and over, the annual incidence of urinary tract infections is approximately 33.4/1000 members.

How do KUTD compare to other broad categories of disease as a cause for morbidity and mortality? Data from the National Center for Health Statistics [9] indicate that the estimated combined death rate from nephritis and nephrosis (ICDA 580 to 584) and infection of the kidney (ICDA 590) was 5.6 per 100,000 in 1977, compared to 302.8 per 100,000 for ischemic heart disease and 174.9 per 100,000 for malignancies. The frequency of these urinary tract conditions as a cause of death are closer to emphysema (ICDA 492) at 8.2 per 100,000 and cirrhosis of the liver (ICDA 571) at 14.5 per 100,000. As a cause of morbidity, however, they are considerably more frequent: During the 5 years of the study in the KFHP population, KUTD was diagnosed at initial hospitalization in 4,139 persons (35.7 per 10,000 members) as opposed to 2,797 persons (24.1 per 10,000) for cancer. Although the nature of the morbidity is quite different for these two groups of diseases, the figures do provide some appreciation of the magnitude of the impact of KUTD.

Unfortunately, no other published data exist with which to assess time trends and possible shifts in the frequency and relative distribution of KUTD. In an analysis of mortality trends for nephritis and infections of the kidney, Kessner and Florey [10] pointed out several problems with such assessments. Although recorded death rates for acute and chronic nephritis have decreased between 1950 and 1964 in the United States, England, and Wales, it is not clear whether this is because of a true drop in the frequency of the nephritides or whether there has been a shift toward diagnosing "infections of the kidney" instead of nephritis, particularly in young women. The authors also refer to evidence that the reduction in overall renal mortality may be the result of "competing mortality" from the arteriosclerotic diseases being recorded as the primary cause of death. In addition, the reciprocal changes in deaths due to hypertension and nephritis in the period 1930 to 1970, noted by Reid and Evans [11], suggest an increasing tendency to attribute uremic deaths to renal damage from hypertension rather than to inflammation.

Although the rates presented in this report are more extensive and specific than have been available previously, they should not be interpreted as the true incidences of KUTD in this population; attention to the limitations of the data is required. Incidence of disease is defined as all new cases of the disease occurring in a defined population in a given period of time. First, mild diseases may not have been recorded because a person did not seek medical care or was seen only as an outpatient. This would result in substantial underenumeration for a disease like urinary tract infection but would probably not influence rates of more serious conditions like cancer of the kidney. Second, because only the first three coded discharge diagnoses were available on the computerized hospital record, some KUTD which may have appeared as the fourth or more diagnosis would not have been counted. Based on our validation review, however, KUTD was not enumerated in only (11/500) 2.2% of medical records without coded KUTD. Third, some cases of diseases may not have been counted because of the use of medical care outside the KFHP system. However, underenumeration for this reason is apparently minimal. A 1971 survey by Field Research Corporation [4] indicated that 3% of the KFHP membership had been hospitalized in outside facilities only (that is, never in a KFHP facility). Many of these visits were outside the service area (presumably due to emergencies), job-related, or the result of referral by KFHP physicians. A second survey by Field Research Corporation in 1976 [4] showed that only 17% had a regular physician outside of the Kaiser-Permanente system for either themselves or a family member. Fourth, hospitalization rates are for initial hospitalization with KUTD within the 5-year period of study and could include cases prevalent at the beginning of the study. This would result in some overestimation of the incidence of KUTD during that period. Finally, computer analysis of diagnostic data recorded as part of the routine practice of medicine has inherent limitations. No standard set of diagnostic criteria is used by all clinicians, and hospital diagnoses are only as specific as allowed by the ICDA rubrics. In this study, we sought to assess the accuracy of diagnoses as well as the magnitude of missed diagnoses by manual review of samples of medical charts. Diagnostic error in the records proved to be small and, except in the case of urinary tract infection, few diagnoses were not recorded in the computer records.

In conclusion, we have presented hospitalization rates for patients with the major types of KUTD among over a million subscribers to a prepaid health plan who are generally representative of the population in the San Francisco Bay area. Despite the limitations discussed, these data are perhaps the most extensive available to date and may prove useful for planning and research purposes.

Acknowledgments

This study was supported by contract N01-AM-62201 from the National Institute of Arthritis, Metabolism, and Digestive Diseases. We thank Drs. N. B. Cummings and J. Hoover for their suggestions. Many Kaiser-Permanente physicians assisted in the data collection, and Dr. Loring Dales initiated much of the data analysis.

Reprint requests to Dr. R. A. Hiatt, Department of Medical Methods Research, Kaiser-Permanente Medical Care Program, 3451 Piedmont Avenue, Oakland, California 94611, USA

References

1. FRIEDMAN EA, DELANO BG, BUTT KMH: Pragmatic realities in uremia therapy. *N Engl J Med* 298:368–371, 1978
2. CUMMINGS NB: *Research in Kidney and Urinary Tract Diseases: Data Book for Fiscal Year 1976*. Bethesda, Maryland, National Institutes of Health, 1977
3. KASS EH: Renal and urinary disorder, in *Preventive Medicine*, edited by CLARK DW, MACMAHON B, Boston, Little, Brown and Co., 1967, pp. 539–552
4. FIELD RESEARCH CORPORATION: An evaluation of the Kaiser Foundation Health Plan of Northern California among current membership. Conducted for KFHP Inc., Northern California Region, June 1976
5. SCOTT G: *Prevalence of Chronic Conditions of the Genitourinary, Nervous, Endocrine, Metabolic, and Blood-Forming Systems and of Other Selected Chronic Conditions, United States, 1973*. Department of Health, Education and Welfare, Public Health Service, Health Resources Administration, National Center for Health Statistics. (Vital and Health Statistics. Series 10: Data from the National Health Survey, No. 109) Publication No. (HRA)77-1536. Washington, D.C., U.S. Government Printing Office, 1977
6. NATIONAL CANCER INSTITUTE, BIOMETRY BRANCH: *Third National Cancer Survey: Incidence Data,* edited by CUTLER SJ, YOUNG JL. (National Cancer Institute Monograph 41) National Cancer Institute, Department of Health, Education and Welfare Publication No. (NIH)75-787. Washington, D.C., U.S. Government Printing Office, 1975
7. TURCK M: Localization of the site of recurrent urinary tract infection in women. *Urol Clin North Am* 2:433–441, 1975
8. GAYMANS R, VALKENBURG HA, HAVERKORN MJ, GOSLINGS WRO: A prospective study of urinary-tract infections in a Dutch general practice. *Lancet* 2:674–677, 1976
9. NATIONAL CENTER FOR HEALTH STATISTICS: *Birth, Marriages, Divorces, and Deaths for January 1978*. Monthly Vital Statistics Report: Provisional Statistics, 27:1–11, April 18, 1978, Department of Health, Education and Welfare, Washington, D.C., U.S. Government Printing Office, Publication No. (PHS) 78–1120
10. KESSNER DM, FLOREY CDUV: Mortality trends for acute and chronic nephritis and infections of the kidney. *Lancet* 2:979–982, 1967
11. REID DD, EVANS JG: New drugs and changing mortality from noninfectious disease in England and Wales. *Br Med Bull* 26:191–196, 1970